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to some extent, when we fix the eye's axes in a given direction; and severely, whenever we wilfully strain our vision—thus astonishing us by the flitting away of objects from our sight, burying some in quasi-lucid clouds, as if they had overspread one another, and as the origin of the phenomenon was undetected, occasioning many surmises upon the inherent qualities of the special nervous structure in order to account for them. An observation upon the inverted image of a candle formed at the posterior face of the crystalline lens is mentioned, which indicates other muscular action besides that which rotates the eyeball, when the eye is vehemently strained, as if the lens becomes flattened. The phenomena which inform us of a differential structure in the retinal surface, with respect to the punctum cæcum, foramen centrale, and the elementary rods and cones, which H. Müller believes to constitute the sentient layer, are adduced; as well as the conclusions to which we are led, after eliminating the various phenomena studied, as regards the ultimate structure of the sentient surface.

VIII. "On Hourly Observations of the Magnetic Declination, made by Captain Rochfort Maguire, R.N., and the Officers of H. M. Ship 'Plover,' in 1852, 1853 and 1854, at Point Barrow, on the shores of the Polar Sea." By Major-General EDWARD SABINE, R.A., D.C.L., Treas. and Vice-President R.S. Received August 14, 1857.

(Abstract.)

Point Barrow is the most northern cape of that part of the American continent which lies between Behring Strait and the Mackenzie River. It was the station, from the summer of 1852 to the summer of 1854, of H.M.S. 'Plover,' furnished with supplies of provisions, &c. for Sir John Franklin's ships, or for their crews, had they succeeded in making their way through the land-locked and ice-encumbered channel by which they sought to effect a passage from the Atlantic to the Pacific. In this most dreary, and apparently uninteresting abode, Captain Maguire and his officers happily found an occupation in observing and recording, for seventeen months unremittingly, the hourly variations of the magnetic declination and of the

concomitant auroral phenomena, in a locality which is perhaps one of the most important on the globe for such investigations. Their observatory, placed on the sand of the sea-shore, was constructed of slabs of ice, and was lined throughout with seal skins. The instruments had been supplied from the Woolwich establishment, with the requisite instructions for their use, and the observations were made and recorded precisely in the same manner as those in the Colonial Magnetic Observatories. The observations were sent by Captain Maguire to the Admiralty, and were in due course transmitted to General Sabine, by whom they were subjected to the same processes of reduction as those in the colonial observatories: the results are given and discussed in this communication.

A sufficient body of the larger disturbances to permit an examination of their laws having been separated from the rest of the observations, it was found at Point Barrow, as elsewhere wherever a similar investigation has been made, that in regard to the frequency of their occurrence, and to the mean amounts of easterly and westerly deflection produced by them, the disturbances follow systematic laws depending on the hours of solar time. The laws of the easterly and of the westerly disturbances were also found, at Point Barrow as elsewhere, to be distinct and dissimilar. On further instituting a comparison between the disturbance-laws at Point Barrow and Toronto, it was found that although the laws of the deflections of the same name at the two stations did not correspond, there existed, on the other hand, a very striking and remarkable correspondence between the laws of the easterly disturbances at Point Barrow and of the westerly at Toronto, and between the laws of the westerly disturbances at Point Barrow and easterly at Toronto. The correspondence is traced in much detail, for the purpose of showing that it is manifested, not in slight and unimportant particulars, but in the most marked characteristics of both classes of phenomena. From the correspondence in the hours at which opposite disturbance-deflections prevail, it follows, that the portion of the diurnal variation which depends upon the disturbances, has opposite, or nearly opposite characteristics at the two stations.

In former papers the author considers that he has shown that, for the purpose of obtaining a correct knowledge of the phenomena of the *regular solar diurnal* variation, it is necessary to eliminate the

influence of that portion of the observed diurnal variation which proceeds from the *disturbances*; and he now adduces the observations at Point Barrow as strongly confirmatory of this. When the diurnal variation is derived from the whole body of the observations at Point Barrow, retaining the disturbances, the westerly extreme of the diurnal excursion, which, as is well known, occurs generally in the extra-tropical part of the northern hemisphere at a little after 1 P.M., is found to take place at 11 P.M.; but when the larger disturbances are omitted, the westerly extreme falls at the same hour as elsewhere, viz. a little after 1 P.M. The author takes occasion to suggest the probability that the anomalies which have been supposed to exist elsewhere in the turning-hours of the solar diurnal variation in high latitudes may be susceptible of a similar explanation.

It appears, therefore, by the comparison of the Point Barrow and Toronto observations, that in the regular solar diurnal variation the progression at the two stations is similar, the easterly and westerly extremes being reached nearly at the same hours; whilst in the disturbance diurnal variation the progression is reversed, the easterly extreme at the one station coinciding very nearly with the westerly extreme at the other. This contrariety seems the more remarkable, since both variations appear to have the same primary or exciting cause, viz. the sun; inasmuch as in each the period is a solar day. The author draws the probable inference, that whilst the primary cause is the same in both, the mode of operation is different in the two cases.

Another important distinction between the phenomena of the solar diurnal variation and of the disturbance variation at Point Barrow and Toronto, is shown by the author to consist in the comparative magnitude of their range. The increase in the range of the solar diurnal variation between Toronto and Point Barrow is, as nearly as may be, in the inverse ratio of the values of the horizontal force of the earth at the two stations (which is the antagonistic force opposing all magnetic variations); whilst on the other hand the increase in the range of the disturbance variation is many times greater than it would be according to the same proportion. It would appear therefore that the absolute disturbing force must be much greater at Point Barrow than at Toronto; suggesting the question, by what physical

or other conditions is the locality distinguished at which the disturbing force is a maximum.

In correspondence with the great amount of the absolute disturbing force at Point Barrow is the frequency of the concomitant auroral manifestations, which greatly exceed that of any previous record known to the author. It was the custom at Point Barrow to attach a distinguishing mark to all the hourly magnetic observations which were made when the Aurora was visible. Taking the months of December, January, and February as those in which, in the latitude of Point Barrow, there is nearly a constant absence of day-light, there were, in those three months in 1852-1853, 1788 hourly observations, at 461 of which the Aurora was visible; and, in the same three months of 1853-1854, there were 1837 hourly observations, at 616 of which the Aurora was seen. There were therefore in the six months 3625 hourly observations, at 1077 of which the Aurora was seen contemporaneously, and at 2548 it was either not present or obscured by clouds: the presence of the Aurora was thus recorded at between one-third and one-fourth of the hours of observation. Or possibly the frequency of its appearance may be more easily judged of by stating, that during these six months the Aurora was seen on six days out of every seven.

The record thus furnished by Capt. Maguire has enabled the author to treat the Aurora, for the first time, in the same way as the corresponding and connected phenomena of the magnetic disturbances are treated, viz. by distributing its recorded appearances into the several hours of their occurrence. A table, in which the particulars of this distribution are contained, shows that 1 A.M. is the hour of their most frequent occurrence at Point Barrow, there having been 102 recorded appearances in the six months at that hour. From 11 A.M. to 3 P.M. is the epoch of minimum, not a single instance of Aurora at any of those hours being recorded in the same six months. The increase from the minimum to the maximum, and the decrease from the maximum to the minimum, are both continuous progressions, with only such very slight occasional interruptions as might assuredly be expected to disappear in mean numbers taken from a longer interval of time.

When the frequency of the Aurora at the different hours is compared with the respective amounts of easterly and of westerly disturb-

ance-deflection at the different hours at Point Barrow, a very considerable approximation towards accordance is perceived between the frequency of the Aurora and the amount of the *westerly* deflections; whilst, on the other hand, the auroral hours appear to have little or nothing in common with the turning-hours, or with the progression, of the *easterly* deflections.